K.R.E.W.S.

Kern River Effort for Watershed Stability

Authors:
Chelsi Campbell, Michael Au, Nick Rutigliano, James Hanes

Table of Contents

MISSION STATEMENT

The Kern River watershed is an important source of water for both agricultural and residential use. Historically, the Kern River watershed has been the subject of controversy due to the unbalanced distribution of water in the state. As a primary source of water for the southern state of California, it is essential to protect and maintain the watershed by allowing sufficient time for groundwater recharge. The Kern River Effort for Watershed Stability (K.R.E.W.S) plans to reduce water consumption in the lower region of Kern River by 20% by 2030 through the diversification of water sources for surrounding counties.

Background

2.1 History

The history of watershed management in the state of California includes the construction of canals, dams, and other structures that were used to distribute water throughout the state. Due to California's unbalanced distribution of water, several projects were constructed to deliver water to the drier parts of the state. Specifically, in the 1860's, the city of Bakersfield experienced major floods from Kern River until the Isabella Reservoir was constructed in the 1950's. Other projects that were used to regulate water flow in Kern River include canals and diversion weirs. During this time, however, water policy placed priority to meeting irrigation demands, which dried up the river in years of drought. As increasing amounts of homes and businesses grew in the area, a community desire developed to preserve water in the river for recreational use and to recharge groundwater aquifers. In recent drought years, the snowpack in the Kern River Watershed has been at record lows, measured at 20% of the average for the area in 2012. The lack of adequate snow accumulation has contributed to a poor recharge of the groundwater table in recent years.

2.2 Watershed Geography and Geology

The Kern River is approximately 165 miles long and is one of four major rivers in the Tulare Lake Basin. It is located at the southernmost section of the basin and its boundaries crosses the three counties: Kern, Inyo and Tulare. This watershed has origins in the North Fork at the Sequoia National Park near the Kern and Tulare boundary as well as at the South Fork in the Inyo National Forest. Theses two forks flow southwards intersecting at the Isabella Dam which then feeds into the Kern River.The watershed contributing to the Kern River includes 2,100 sq miles of watershed area above the Isabella Dam, 300 sq miles from the foothills below the Dam and another 600 sq miles from the Kern River Canyon. The Dam has a total storage capacity of 568,500 acre-feet (at spillway crest), 360,000 acre-feet (USACE storage restriction) and 170,000 acre-feet of carryover storage. The major benefit to the dam is flood control but is also used for irrigation, generating electricity, and as a recreational facility. Downstream from the dam the river flows southwesterly towards Bakersfield.

Figure 1 shows the watershed delineation of Kern River.

As the Kern River exits the Sierra Nevada foothills the sharp change in gradient causes the water body to spread out and create an alluvial fan in the San Joaquin Valley as the flow becomes unconfined. The soil type immediately outside the Kern Canyon consists primarily of loosely packed sand and gravel called alluvium. This porous material is favorable of infiltration and creates a vast underground water supply of approximately 93 million cubic feet.

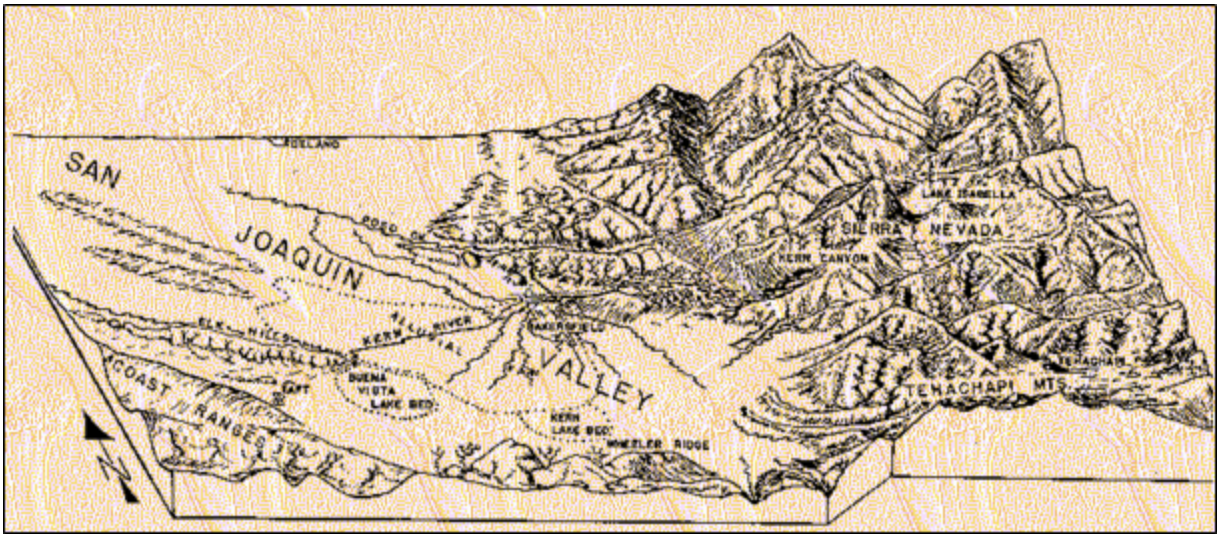


Figure 2 shows the alluvial fan of the Kern River as it leaves the Sierra Nevada foothills.

Kern County is heavily dependent on this typically abundant groundwater storage as its primary source of water but in recent years the supply has dwindled significantly. There are multiple factors affecting the Kern River flow rate contributing to the groundwater storage. One of these factors is the steady rise in temperature over the last decade causing a rise of evapotranspiration rate which is currently estimated at 65 percent. Another major factor is the

significant decrease of snowpack deposited in the winter months by 95 percent. The majority of Kern River water comes from snowmelt, peaking between April and July. When it comes to snowmelt and other forms of precipitation, this region is highly variable. Annual precipitation in this region is 13.24” but this is deceptive since this area is plagued by frequent droughts and an occasional El Nino year that skews average rainfall.. For example, this past year was an El Nino year which is characterized by unusually warm pacific water which yields plentiful precipitation. Due to the severe droughts California has faced in recent years, this year's El Nino only put a dent in the water scarcity. During dry years surface water supplies are supplemented by pumped groundwater, while wet years provide for recharge to groundwater.

The South Fork Kern River at its northern point is comprised of granite and extrusive material near the Golden Trout Volcanic field. Being a major contributor to the Kern River, the South Fork contributes a good load of sediment since granite is easily eroded. After the completion of the Isabella Dam, sediment loading decreased downstream and increased upstream from the dam due to reduced flow. Just beneath the dam the flow to the river is greatest. Farther downstream, flow is reduced again and is susceptible to high sediment. Sediment itself isn’t as dangerous as the contaminants that are adsorbed by the sediment which is often a concern in the Kern River Valley.

2.3 Population

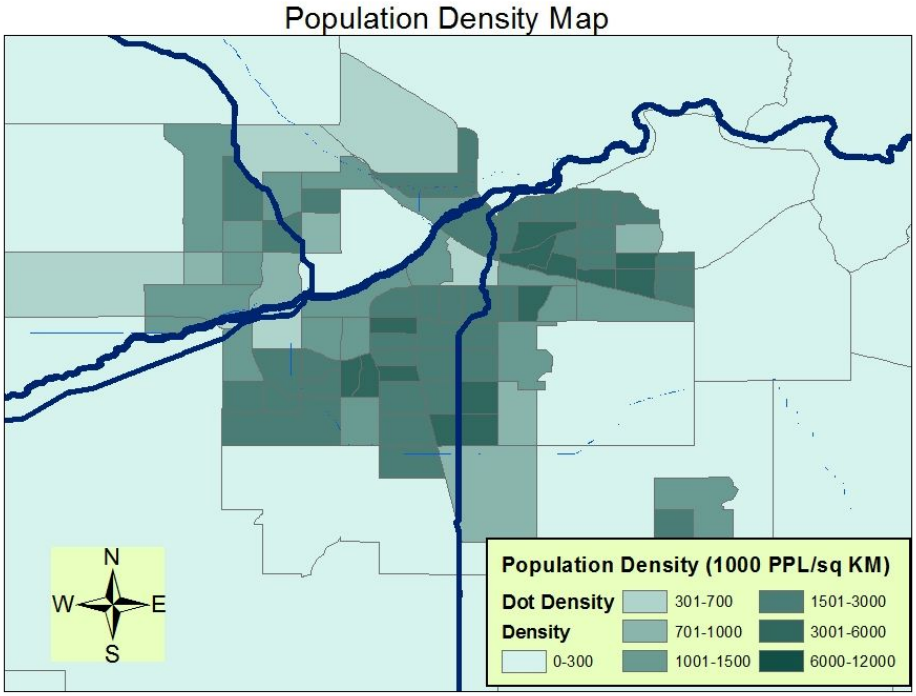


Figure 3 shows the population densities for counties surrounding Kern River.

2.4 Land Use

Land use in the Kern River region is highly divided between urban, rural and agricultural areas. Figure 4 provides a map of the various land uses in the region. Most of the region population surrounds the middle to lower portion of the Kern River which is depicted by urban areas and the dot density shown on the map. Bakersfield remains the most populated city in the area (just over 360,000 people), followed by Delano (over 50,000 people), and then Shafter and Wasco (both less than 10,000 people). To the northeast in the North and South Fork basins is predominately natural land with vast undisturbed mountain ranges with very little population (~15,000 people). These areas are heavily recreational, providing rafting and leisure throughout the rivers and lakes. It is important to limit urban sprawl towards these regions to maintain watershed stability.

Agriculture is an incredibly important land use in Kern County and is vital to the local economy. This area alone produces over 250 crops yielding an annual value of $3.5 billion revenue, and 98% of these lands are irrigated. Between the years of 1990 and 2006, the amount of vital farmland decreased by 88,338 acres as a result of urbanization. Long term water supply planning is important to ensuring rural and economic growth can be accommodated.

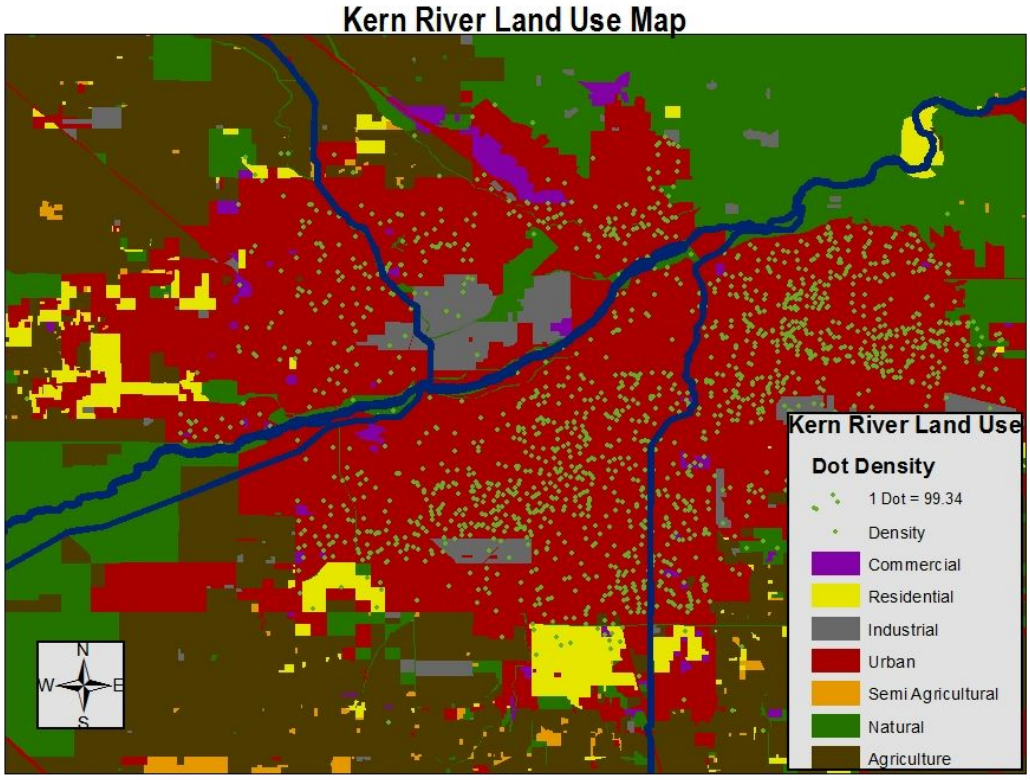


Figure 4 is a map displaying land use surrounding Kern River.

2.5 Water Use

Historically, Kern River has been a major source of water for various uses. Allocating different uses adequate water is a difficult science due to the varying water quantity. Water supply planning must take into consideration water that is currently available, the current water requirements, and the target carryover storage for the following season. In 2008, total crop water demand for agricultural uses was about 186,000 acre feet (evapotranspiration factored in), and groundwater recharge uses was about 28,000 acre-feet. Groundwater recharge is accomplished through 1,500 acres of spreading ponds and unlined canals. Municipal and Industrial water use is accomplished almost entirely by groundwater pumping. As the land uses in the Kern River Valley change, the future demands for water will also change. For example, the area adjacent to Kern River has experienced urbanization at the expense of agricultural land which would likely have led to a decrease in surface water irrigation and an increase in groundwater pumping. It is likely also that there is less recharge with impervious areas and piping of wastewater to treatment facilities for reuse.

According to the Kern County Water Agency, Kern River provides approximately 745,000 acre-feet per year to 8 different districts as shown in Figure 5 and broken down in Table 1.

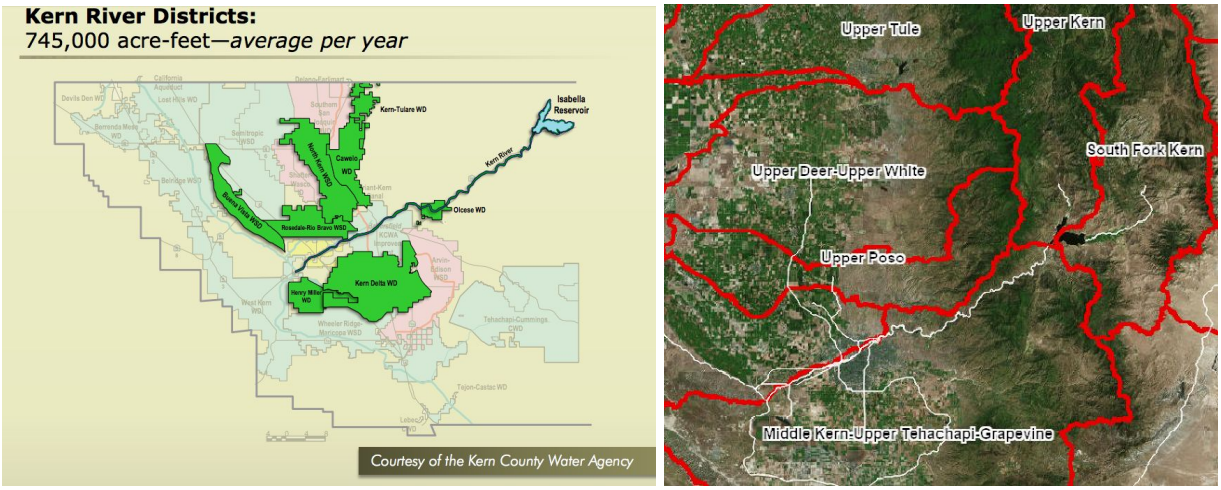


Figure 5 shows the districts that use Kern River as a source of water.

District	Water From Kern River
-	*acre-feet/year*
Buena Vista WSD	145,000
Cawelo WD	90,000
Henry Miller WD	35,500
Kern Delta WD	205,000
Kern - Tulare WD	40,000
North Kern WSD	175,000
Olcese WD	44,500
Rosedale - Rio Bravo WSD	10,000
Total	745,000

Table 1 shows the amount of water from Kern River distributed to surrounding districts.

Environmental Concern

3.1 Sedimentation along the southern section of the Kern River

The effects of heavy sediment loads down river is not only costly to the water treatment plants, but are also environmentally taxing. Sedimentation can affect river flow, biological processes, and change/alter sensitive habitats. Figure 6 shows the dynamic effects sediment loads have had on the Kern River over a four year period. Such rapid change in habitat can be determinantal to sensitive vegetation and keystone species native to the area. Also, deterioration in habitat conditions along the banks and within the channel bed allows for the introduction of non-native and invasive species.

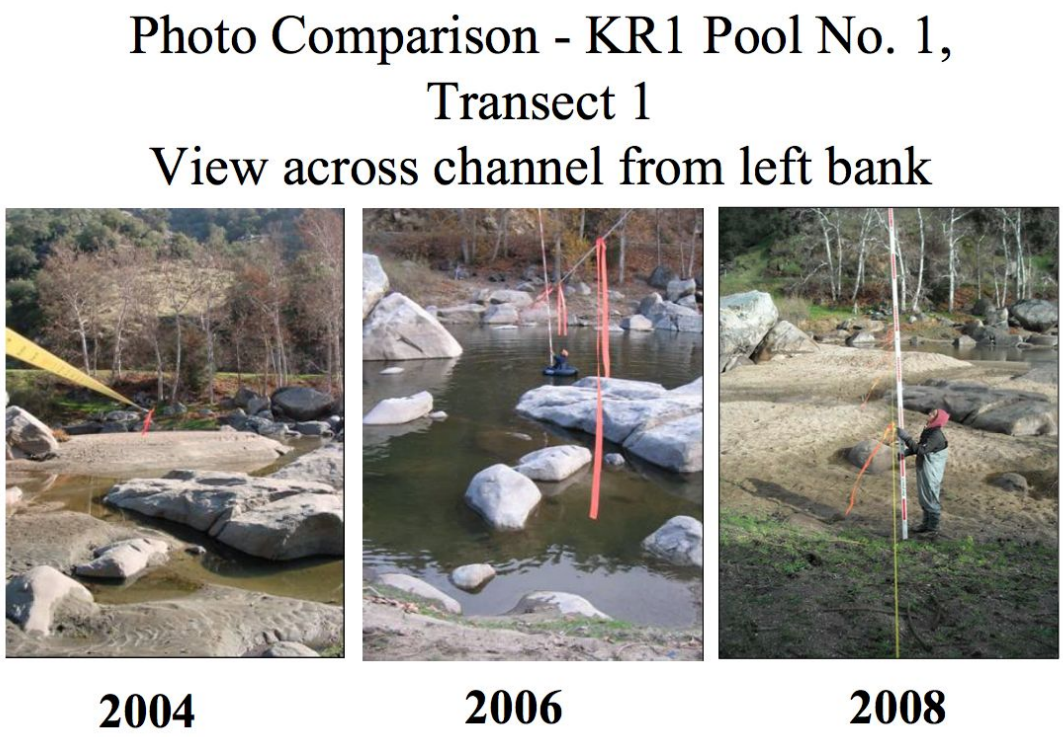
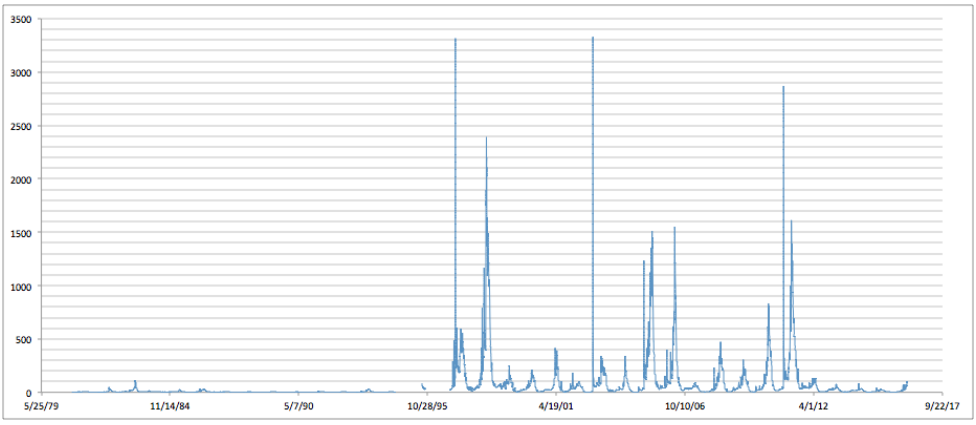


Figure 6 shows the effects of sedimentation in habitat over a four year span along the same transect section of the Kern River.

3.2 River Temperature and Flow

With the recent drought conditions and unusual warm seasons in California, water temperatures along the river to have begun to slightly increase. Increasing water temperatures by only 2-5 degrees celsius can affect species that have a narrow range of tolerance such as the rainbow trout and can increase biological processes such as photosynthesis under proper conditions. Low flow conditions due to drought conditions and decreasing snow melt have had adverse affects on water temperature as well.



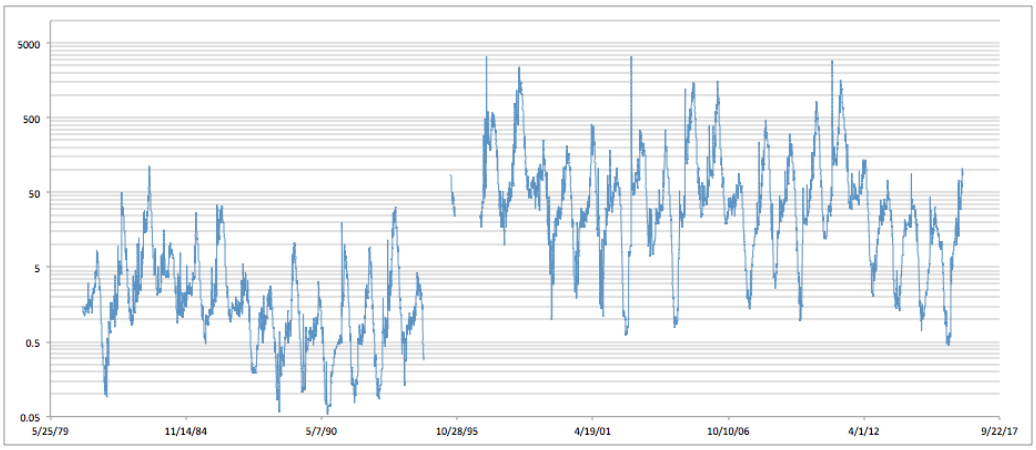


Figure 7 Kern River discharge for the past 30 years (Bottom graph includes same data, but uses a logarithmic y-axis scale).

The recent drought conditions are clearly seen on the hydrograph for the Kern River Figure 7. Also, the major changes to the river bank, shown in Figure 6 are directly correlated to the major discharge events of that year shown in the hydrograph. However, even during the longer periods of low flow conditions the river channel and banks are constantly changing from year to year, Figure 8. These changes during periods of low precipitation indicate runoff during precipitation events due to the land use and geology of the drainage basin.

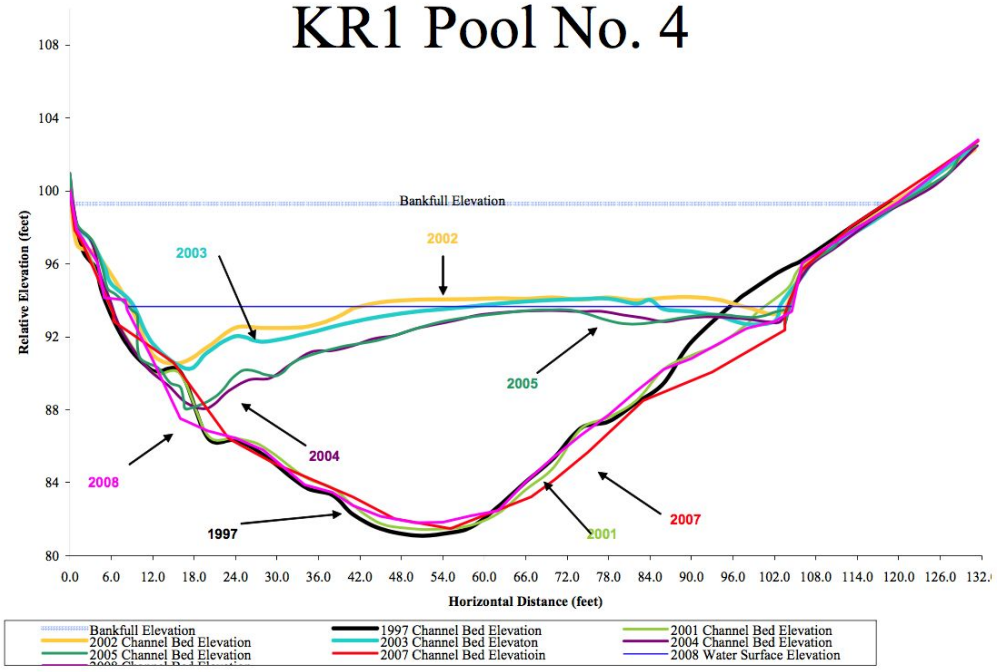


Figure 8 Transect section of Kern River showing channel bed elevation over 11 years.

Existing Laws, Programs and Organizations

Kern River Watershed Coalition Authority (KRWCA) - The Kern River Watershed Coalition Authority serves as the coordinator and third-party group under the Irrigated Lands Regulatory Program. They signed a Joint Powers Agreement on October 1, 2011 with 10 different water districts in the Kern County portion of Kern River. This organization represents owners/growers of irrigated agricultural lands.

Kern Integrated Regional Water Management Plan (Kern IRWMP) - This organization is a group of water suppliers, government representatives, environmental groups, and businesses who collaborate in order to preserve the economic and environmental health of Kern County.

Irrigated Lands Regulatory Program (ILRP, 2003) - The primary goal of this program is to prevent agricultural runoff from contaminating surface waters. The program was approved in 2003 and in 2012, groundwater regulations were added to the program.

Upper Kern Basin Fishery Management Plan (1995) - The primary goals of this management plan are to protect native fish populations, restore rainbow trout populations, and provide for recreational fishing. This plan is primarily focused on the portion of Kern River in Sequoia National Park and was approved in April of 1995.

The Kern River Flow and Municipal Water Program (2012) - This program is a flow management and water supply program. The primary goals of this plan is to increase water flow to Kern River in order to protect, increase, and enhance the city of Bakersfield's water supply.

The California State Water Action Plan (2014) - This statewide water action plan has primary goals to reduce water demand, increase water supply, and improve water quality in order to develop a sustainable water management system.

The Water Boards' Strategic Plan 2008 - 2012 - The primary purpose of this strategic plan is to develop sustainable practices that protect water quality and preserve water resources. The goals of the plan include improving groundwater quality, increase sustainable water supplies, and to address water quality protection.

Objectives

- Reduce water consumption by 20% over the next 15 years by irrigating with recycled wastewater and graywater

- Reduce sediment loads in Kern River by 15% over the next 10 years by implementing best management practices, remediation of eroded stream banks, increasing the riparian zone, and improving storm water runoff.

- Reduce erosion on the banks of the Kern River by 20% over the next 15 years through riverbank remediation, preservation of open spaces, increasing the riparian zone, grading, and stormwater management

- Increase native Kern River Rainbow Trout population by 20% over the next 30 years to by habitat preservation, increasing bank vegetation and cover, increasing dissolved oxygen levels, decreasing invasive species/predators population, and continuous monitoring.

Problem	Result	Cause
1. Pollutants	Contamination of surface water and groundwater leads to unsafe drinking water.	Stormwater runoff picks up agricultural nutrients that impair surface and ground waters.
2. Invasive Species	Decreasing population of the native Kern River Rainbow Trout.	Hybridization of the native and invasive species decreases genetic integrity.
3. Heavy Recreational Activities	Destruction of Kern River Rainbow Trout habitat.	Increased recreational activities such as angling destroy the native habitat.
4. Low Water Levels During Dry Months	Lower region of Kern River dried up in summer seasons.	Inefficient distribution of water, low precipitation, insufficient time given for groundwater recharge.
5. Increased Sediment Loads/Small Riparian Zone	Destruction of habitat and river bank.	Erosion due to large sediment loads and a small riparian zone.

Table 2 shows the problems, results, and causes of the issues related to the Kern River Watershed.

Solutions

Problem	Goal	Solution
1. Pollutants	Reduce pollutants contaminating surface water by decreasing stormwater runoff.	Stormwater management, construct drainage basins or floodplains to reduce runoff, more legislation to regulate agricultural pesticides.
2. Invasive Species	Protect native population of Rainbow Trout from competition with non-native species.	Reduce planting of non-native trout, increase the riparian zone to protect habitat.
3. Heavy Recreational Activities	Protect the habitat for the native Kern River Rainbow Trout species.	Decrease or monitor heavy recreational activity in Kern River.
4. Low Water Levels During Dry Months	Reduce water consumption by 20% over next 15 years.	Recycle wastewater, use graywater, legislation for more efficient allocation of water distribution.
5. Increased Sediment Loads/Small Riparian Zone	Reduce erosion on the Kern River bank.	Increase the riparian zone surrounding Kern River, Record and analyze Rapid Assessment Reports over time.

Table 3 shows the problems, goals, and solutions of this plan.

References

[1] *Agricultural Water Management Plan. Rep. North Kern Water Storage District. Web.*

[2] *"California Water Action Plan." California Natural Resources Water Agency. Web. 06 Apr. 2016.*

[3]“California’s Native Fish Crisis.” *California Trout*. Web. 06 Apr. 2016

[4] "Geology of the Kern River Valley." *Audubon California Kern River Preserve*. Web. 06 Apr. 2016.

[5] *Hardhead and Trout in the Kern River*. Rep. California Department of Fish and Game. Web.

[6]"High Vulnerability Areas." *Kern River Water Coalition Authority*. Web.

[7]"Hydrogeology of the Kern River Alluvial Fan." *San Joaquin Valley Geology*. Web. 06 Apr. 2016.

[8] "Irrigated Lands Regulatory Program (ILRP)." *Central Valley Regional Water Quality Control Board*. Web. 06 Apr. 2016.

[9]"Issues." *Water Association of Kern County*. Web. 06 Apr. 2016.

[10] "Kern County Integrated Regional Water Management Plan." *Kern County Integrated Regional Water Management Plan*. Web. 06 Apr. 2016.

[11] "Kern River Flow and Municipal Water Program and EIR." *Horizon Water and Environment*. Web. 06 Apr. 2016.

[12] *Kern River No. 1 Sediment Management Practices*. Rep. Kern River Fly Fishers. Web.

[13] *Tulare Lake Basin Hydrology and Hydrography: A Summary of the Movement of Water and Aquatic Species*. Rep. US Environmental Protection Agency. Web.

[14] "USGS Current Conditions for USGS 11189500 SF KERN R NR ONYX CA." *Unites States Geological Survey*. Web. 06 Apr. 2016.

[15] "Water Boards' Strategic Plan." *California Environmental Protection Agency:State Water Resources Control Board*. Web. 06 Apr. 2016.